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तरल शक्ति तंत्र प्रयोगों के लिए पारस्परिक सील — परीक्षण पद्धति

Indian Standard

SEALS FOR RECIPROCATING APPLICATIONS USED IN FLUID POWER SYSTEMS — METHODS OF TEST

UDC 621·22 : 621-762·6 : 620·1

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

March 1995

Price Group 2

Basic Fluid Power Sectional Committee, PE 14

FOREWORD

This Indian Standard was adopted bv the Bureau of Indian Standards, after the draft finalized by the Basic Fluid Power Sectional Committee had been approved by the Production Engineering Division Council.

In hydraulic fluid power system, power is transmitted and controlled through a fluid under pressure within an enclosed circuit. Seals protect the sealing devices which contain the pressurized fluid within components with moving parts.

This standard prescribes the physical and performance test methods for various types of seals used in hydraulic fluid power systems. Performance requirements of fabric reinforced rubber seals and pneumatic seals have not been included in this standard. In actual application, in fluid power system, generally the medium used is mineral oil, as such the same has been specified as test oil.

In the preparation of this standard, assistance has been taken from JIS B 2403-1977 'V-packings', issued by the Japanese Standards Association.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

SEALS FOR RECIPROCATING APPLICATIONS USED IN FLUID POWER SYSTEMS — METHODS OF TEST

1 SCOPE

This Indian Standard covers test methods and test conditions for physical properties of seal material (homogeneous rubber) and performance criterion of seals which are subjected to reciprocating motion in fluid power systems. This standard does not cover tests for fabric reinforced rubber seals and pneumatic seals.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
410 : 1977	Cold rolled brass sheet, strip and foil (*third revision*)
1730 : 1989	Dimensions for steel plates, sheets, strips and flats for general engineering purposes (*second revision*)
3400 (Part 1) : 1987	Method of test for vulcanized rubbers : Part 1 Tensile stress-strain properties (*second revision*)
3400 (Part 2) : 1980	Method of test for vulcanized rubbers : Part 2 Hardness (*first revision*)
3400 (Part 4) : 1987	Method of test for vulcanized rubbers : Part 4 Accelerated ageing (*second revision*)
3400 (Part 6) : 1983	Method of test for vulcanized rubbers : Part 6 Resistance to liquids (*first revision*)
3400 (Part 10) : 1977	Method of test for vulcanized rubbers : Part 10 Compression set at constant strain (*first revision*)
6911 : 1992	Stainless steel plate, sheet and strip (*first revision*)

3 PHYSICAL TESTS

3.1 Physical Properties

The physical properties of homogeneous rubber (Nitrile or its compound in this case) shall conform to the requirements specified in Table 1.

3.2 Test Method for Permanent Deformation in Relation to Applied Deformation

3.2.1 Inner diameter of the seal shall be increased by $0{\cdot}35 \times \sqrt{\text{Piston rod diameter}}$ by a suitable mandrel. The sample along with the mandrel shall then be immersed in test oil for 24 h at 120°C. The sample shall be taken out and permanent deformation on seal inside diameter shall be measured after oil reaches room temperature.

$$\text{Permanent deformation, percent} = \frac{da - db}{db} \times 100$$

da = inside diameter of seal after test.

db = inside diameter of seal before test.

3.2.2 Outer diameter of the seal shall be increased by $0{\cdot}35 \times \sqrt{\text{Bore diameter}}$ by a suitable tube. The sample along with the tube shall then be immersed in test oil for 24 h at 120°C. The sample shall be taken out and permanent deformation on seal outside diameter shall be measured after oil reaches room temperature.

$$\text{Permanent deformation, percent} = \frac{Db - Da}{Db} \times 100$$

Da = outside diameter of seal after test.

Db = outside diameter of seal before test.

3.3 Bending Test

For this test, two test samples of 2 to 3 mm thick, 15 mm wide and 100 mm long shall be taken from each direction of the material sheet. This test, for all the four test samples, shall be carried out by wrapping them around a steel mandrel of 5 mm dia through an angle of 180°. After the test, no crack shall appear in longitudinal or lateral direction.

3.4 Corrosion and Tacking Test

3.4.1 When the rubber seals are tested in accordance with the method given in **3.4.3**, the seal shall neither cause corrosion nor produce tacking to the metal that comes into contact with the seal. However, the change in colour on the surface of the metal shall not be regarded as corrosion.

Table 1 Physical Tests

(*Clause* 3.1)

Sl No.	Characteristic	Requirement	Test Conditions
i)	Hardness, IRHD	90 ± 5	Unconditioned sample As per IS 3400 (Part 2) : 1980
ii)	Tensile strength		Unconditioned sample
	kgf/cm^2, *Min*	100	As per IS 3400 (Part 1) : 1987
	MPa, *Min*	10	Dumb-bell test specimen
iii)	Elongation, percent	100	do
iv)	Tensile stress (under 100 percent elongation)		do
	kgf/cm^2, *Min*	70	
	MPa, *Min*	7	do
v)	Ageing		As per IS 3400 (Part 4) : 1987
	a) Change of IRHD hardness, *Max*	+10	Temperature 100°C Time 70 h
	b) Change of tensile strength, percent, *Max*	–20	do
	c) Change of elongation, percent, *Max*	–50	do
vi)	Compression set, percent, *Max*	75	As per IS 3400 (Part 10) 1977 Temperature 100°C Time 72 h
vii)	Oil resistance test		As per IS 3400 (Part 6) : 1983
	a) Change of IRHD hardness, *Max*	– 5 to + 10	Temperature 100°C Time 70 h
	b) Change of tensile strength, *Max*	–20	Test oil No. 1 as per Appendix A of IS 3400 (Part 6) : 1983 to be used
	c) Change of elongation, percent, *Max*	–40	
	d) Change of volume, percent	– 10 to + 5	
	e) Change of IRHD hardness	–10 to + 5	As per IS 3400 (Part 6) : 1983
	f) Change of tensile strength, percent, *Max*	–35	Temperature 100°C Time 70 h
	g) Change of elongation, percent, *Max*	–35	Test oil No. 3 as per Appendix A of IS 3400 (Part 6) : 1983 to be used
	h) Change of volume, percent	0 to + 20	
viii)	Permanent deformation, percent, *Max*	5	As per **4.1**

3.4.2 Test pieces 25 mm wide, 50 mm long, shall be taken from the sheet material of 2 to 3 mm in thickness which are manufactured under the same conditions as the seals.

3.4.3 The samples are stacked alternately between brass sheet (according to IS 410 : 1977), steel sheet (according to IS 1730 : 1989) and stainless steel plates (according to IS 6911 : 1992) of same dimension as the test samples, surface of which are well polished and these are piled up in close contact with each other. The samples duly stacked shall be kept in a thermostatic vessel for 24 h at a temperature of 70 ± 1°C. After the test there shall be no corrosive and tacking effects on the surface.

4 PERFORMANCE TEST

4.1 Performance Test Equipment

a) Test equipment consists of a suitable housing for retaining test fluid and for positioning the test seal, for example cylinder.

b) A reciprocating member for example piston rod driven by suitable device.

c) The test equipment shall be either vertical or horizontal.

d) The test equipment shall be suitably designed to fulfill the requirements of actual operating condition of the seal.

e) The test equipment shall be suitably supported to ensure minimum vibration and distortion.

f) A suitable means shall be provided for collecting and measuring the fluid leakage from the test seal.

g) The temperature of the test oil shall be maintained within ±5°C of the specified temperature.

4.2 Performance Test Conditions

Testing conditions shall conform to Table 2.

4.3 Performance Rating

4.3.1 *For U-Seals and V-Packings*

4.3.1.1 Test sample when tested in the test equipment in accordance with the conditions given in Table 2, the maximum amount of oil leakage per seal shall be 2 ml/1 000 strokes or less for homogeneous rubber seal.

4.3.1.2 The amount of oil leakage shall be measured at over 10 000 motions and be converted into the amount of oil leakage in terms of every 1 000 motions.

4.3.2 *For Wiper Seals*

After running in test equipment and under test conditions for 1 000 motions, wiper seal shall function in such a way that a thin layer of oil remains for lubrication of seal and no dirt is allowed to enter the test cylinder.

Table 2 Performance Test

(*Clauses* 4.2 *and* 4.3.1.1)

Item	Test Condition	Remarks
Test oil	Petroleum based hydraulic oil	—
Test temperature of oil	Room temperature at 70°C	Oil temperature shall be measured in test chamber under pressurized condition
Test pressure	100 bar ± 5 (10 MPa + 0·5)	Static pressure is allowed
Speed	Motion – 30 to 40 stroke/min Piston stroke 100 to 110 mm 12 m/min approx	Applicable for U-seals only Applicable for wiper seal and V-packings
Surface finish of piston rod	N5	Application for rod seals
Surface finish for cylinder bore	N4	Application for piston seals
Number of motion	50 000	Intermittent motion is allowed

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This Indian Standard has been developed from Doc : No. PE 14 (5149)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed at Printwell Printers, Aligarh, India